Design and Implement of University Laboratory Equipment Network Management Platform Based on C/S and B/S Model

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Abstract—**Lacking management of laboratory equipment in university currently, a strategy was proposed to manage laboratory equipment with network method by using software architecture based on C/S and B/S model. Network management platform for experimental equipment is a management system, which is also a complex monitoring system. For different users, being designed by reasonable software architecture, it will make better prospects for the system. This paper presents a framework of laboratory equipment management system of hybrid system, which includes the realization of main function, architecture, database design and implementation.**

Keywords-Mixed structure of C/S and B/S model, Equipment management system, Data sharing

I. INTRODUCTION

Laboratory is an important part in management of university that cannot be ignored. With the exoteric laboratory, teaching, research workload and increased foreign exchange, information-sharing of devices and systematic management are required urgently in university In the traditional way, information processing of equipment management in university is carried out manually. In this way, it is not only waste paper, but also require many human resources. Most device management softwares currently in use are single-user mode, but disadvantage is that data cannot be shared and management is non-transparent and difficult to monitor. C/S(Client/Server) application structure can not only achieve the share of database resources, but also improve the security of the database. This structure model is a multi-user application development model, in which a server can provide services for multiple clients at the same time. Server is responsible for management of system resources effectively; Client accomplishes the task that interacts with users and data According to the command, service area executes corresponding data operation, which only returns final results to the user; thus, the amount of data transmission on the network could be reduced and performance of the system could be improved. By this way, C/S structure is very suitable for the need of equipment management system. At the same time, B/S(Browser/Server) model changes Fat-Client/Thin-Server structure of C/S into Thin-Client/Fat-Server structure, and unified browser software is the only software needed to be installed at client. Besides, because its based on TCP/IP protocol and HTTP protocol, cross-platform issues could be solved perfectly and each operating system could compatible well on different models. In sum, at one hand, C/S model structure has a strong management capacity, which is suitable for fast information processing in intra-net system; on the other hand, B/S model have a good network scalability and compatibility. In terms of the management of laboratory equipment in university, because laboratory equipment of each college is stored in scattered locations, the use of hybrid structures(C/S and B/S) can ensure the relative safety of internal database. By highly interactive with internal users, its functions can meet the requirements of quick response of data query and amendment.

II. SYSTEM DESIGN

A. System Architecture Design

Having analysed and researched management mode of each device management department, we decided to establish production management information system of laboratory equipment by taking into account actual demand of manager and user of device. Whole system could be divided into two sections: MIS can be realized by C/S model structure in intra-net of university and applications on Web server apply B/S model structure, by which users can make an appointment of experimental equipment through Internet. Database server stores all information and data which relates to equipment management. Web server is an interface for network users accessing database server which is an execution platform of web applications. Network topology of the whole system is shown in Fig. 1:
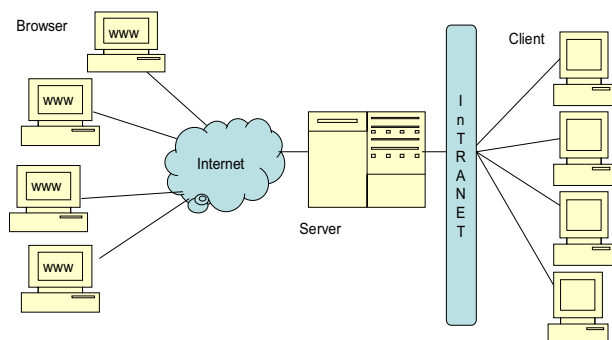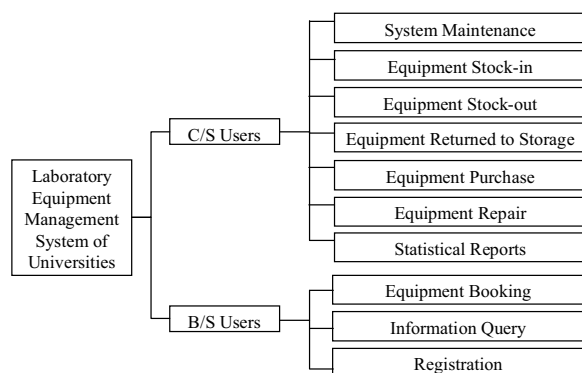
Fig. 1 Network Topology

Fig. 2 Block Diagram of Overall System Functions

System Management Module of C/S Part

- System Maintenance and Management: This function module is mainly to provide functions, such as management and maintenance of user role and permissions, management of user's keyword, maintenance and management of system utilities code, system operation, log management, management of system update and upgrade, etc.
- Equipment Stock-in: This application module is mainly to realize stock-in management for brand-new equipment, including operations such as records moving, finding, printing, adding, editing and deleting.
- Equipment Stock-out: This application module is mainly to mark equipment and to manage scrapped equipment which are lend out, including operations such as records moving, finding, printing, adding, editing and deleting. Stock-out need to some specific works which are shown as follow:
- Equipment Returned to Storage: This application module is mainly to realize the management work of laboratory equipment which returned to storage, including operations such as moving records, finding, printing, adding, editing, deleting, etc.
- Equipment Purchase: This application module is mainly to realize procurement management of laboratory equipment, including operations such as moving records, finding, printing, adding, editing, deleting, etc.

By analysing business processes of lab equipment management, system design is decided by discussion. According to the specific requirements of the management system, users of whole management system could be divided into two types: C/S users and B/S users and users can use respective functions according to different permissions.

- Records of Equipment Repairing: This application module is mainly to realize the registration and management of maintenance records of equipment, including information on maintenance equipment, maintenance time, cost, etc, also including operations such as moving records, finding, printing, adding, editing, deleting, etc.
- Printing Statistical Reports: This application module is mainly to calculate usage of equipment (daily, weekly, monthly) automatically and number of experiments. By implementing print job for all data tables of the system, functions of the system such as hard copy for data resources, statistical reports and signature of responsible person are to be accomplished.

Part of the system functions of B/S structure

This part is mainly about web management system, which relates to the function that query information about equipment management through Internet. B/S users include students and teachers who prepare for appointing experiments. Leaders of college and university would like to apply for registration of user name and password from administrator through browser. Main functions are shown as follow:

- Data Query: According to instrument name, instrument code and instrument model, current state of instrument is inquired, such as booking, lending, being returned, pending lending, etc.
- Equipment Booking: by querying on web, instrument borrower could get to know related basic information of instruments available for booking and book instruments. All appointment times and instrument information are listed on web clearly. Users can adjust time scale according to actual needs by themselves. Administrator can verify booking information through management interface when system send e-mail to inform administrator systematically, once users login booking data on web.
- Account Permissions and Password Management: users can build respective account and password which is audited by system administrator before it is confirmed. Users can book and query unless input account and password exactly.

C. Database Design

Background database of laboratory equipment management system will store various types of data and related parameters, such as equipment data of each process of purchasing, store-in, utility, maintenance, store-out, basic information and permission information of manager, user's information and parameters of each module, etc. According to system needs, we design database and its tables. Some tables are fixed structure and some tables are built by user's self-define function during setup process of interface operation. Part of the table structure and field information is shown in Fig. 3.

System Users	Instrument	User's	Lending Information
User Code Name Gender User Name Password Department Major ID Number Permission Level Management Permission	**Instrument Number** Instrument Name Instrument Manufacturer Instrument Model Date of Purchase Date of Stock-in Price Bar-code Complete State	**Number** Barcode of Campus Card Name Gender ID Card Student ID College Major	**Lending Number** Barcode of Campus Instrument Number Date of Lending Date of Returning Overdue Fine Deposit for Valuable Instrument Compensation for Losing Compensation for Damage Borrowed-instrument Code Borrowed-instrument Name Borrowed-instrument Manufacturer

Fig. 3   Part of Data Table Structure

III.   SYSTEM IMPLEMENTATION

A.   Implementation of C/S Mode

Efficiency of application development is improved with CSharp in C/S module in visual programming environment and ADO data access. Applications on client offer interface to access to server data for users. Most of system's businesses are achieved on server and then offer to client. Database server is responsible for providing source of data. This part is achieving concretely as follows: when clients access to data, client program will research server program automatically and then send request. Server program connects to database through ODBC driver according to predefined rules calling ADO object in order to execute operations for database and results are sent to users at last.

B.   Implementation of B/S Mode

This part achieves concretely as follows: first of all, when browser requests access to a file extended by .asp, web server runs appropriate ASP program which calls ADO object to connect to database through ODBC driver. Then, program executes operations such as finding, editing, etc. At last, results of execution are returned to browser from web server with HTML format. For programming corresponding ASP applications, users can exchange information with database on web browser.

IV.   SUMMARIES

The construction of system must take into account workflow of management of university laboratory equipment, so that it can realize network and pattern of modern office equipment management. By constructing network platform of equipment management platform, it is a way to achieve the scientific management of laboratory equipment and to avoid weak-points which bring by the traditional manual manage method or stand-alone system management. According to different functions of modules in university laboratory equipment management system and the specific requirements of data processing, we decide to use C/S or B/S access mode. By improving management level of laboratory equipment and equipment efficiency, network laboratory equipment management for every manage layers can be realized.

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